Weights and Measures in Pre-Columbian America*

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THE existence of a system of posology in the ancient cultures of the Old World has been widely established. Of particular interest to medicine is the study made by Leake (1952)[1] of quantitative measurement in therapeutics as in the Egyptian Papyri. Study of similar documents of the American aborigines, such as the *Badianus Codex* (1952),[2] has not revealed any reference to measurement by weight in the administration of pharmaceutical preparations prior to the arrival of the Spanish conquistadores. Even centuries after that event, the medical manuscripts of the Maya, such as the *Chilam Balam de Ixil,* use only vague quantitative measurements for doses—"a handful" of herbs and similar expressions. After analysing documents relating to taxation, such as the *Mendoza Codex,* historians have arrived at an idea of some units of measurement for certain goods and staple products which were to be part of the tribute due each year to the rulers.

In 1956, in the course of a search for manuscripts pertaining to American materia medica, an old anonymous manuscript dealing with the history of physical and biological sciences of the pre-Columbian period was discovered. This manuscript was identified as the work of Antonio de León y Gama (1735-1802), a Mexican scientist and author, who used the same codices and sources of information as Siguenza y Góngora, Boturini Benaduci, and other early historians of American antiquities. The manuscript of León y Gama (ca. 1790), transcribed in extenso and properly edited, with biographical and bibliographical notes, will appear elsewhere.[3] At this time only a short summary of the chapters on weights and measures is offered.

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1 Leake, Chauncey D. *The old Egyptian medical papyri.* Logan Clendening Lectures on the History and Philosophy of Medicine. Lawrence, Kansas, University of Kansas Press, 1952. [x], 108 pp.

2 Guerra, Francisco. *Libellus de medicinalibus Indorum herbis. El manuscrito pictorico mexicano latino de Martin de la Cruz y Juan Badiano de 1552.* Estudio, texto, y versión. México, Editorial Vargas Rea y El Diario Español, 1952. xii, 258 pp.

3 Guerra, Francisco and Guerra, Shirley M. J. de. A history of physical and biological science in pre-Columbian Mexico, by Antonio de León y Gama (1735-1802). [In preparation.]

In his second letter to Charles V, shortly after the conquest of Mexico in 1521, Hernan Cortés remarked that the Mexicans sold everything by number and measure but never by weight. Gómara mentioned that among the Chibcha on the coast of Cartagena some system of weighing was employed. A controversy arose over the statement of Francisco Pizarro, that in Tumbez, Perú, he had observed a Roman scale being used by the Inca to weigh gold: this record is now understood to refer to a European contrivance imported by the Spanish since no other example of such a scale has been discovered.

Furthermore, there is no word in the Nahuatl language for weight, and after the conquest of Mexico the Aztecs named the officer in charge of weighing the silver at the Mint *Tlatamachihuani,* meaning the one who measures. A system of standards for volume and length can be established in Nuclear America prior to the arrival of the Spaniards, and, though these standards are not as detailed as those of the Roman system, they seem to have been fairly widespread in their application.

In the *Mendoza Codex* there is a reference to the *Quauhchiquihuitl,* which was a wooden box like the Spanish *fanega* used for measuring corn and other dry goods. This box was divided in half, and then again until it reached one-twelfth part of the original amount, the smallest amount being named *Tlatamachihualoni.* The cocoa-bean, one of the most important products for tribute (for chocolate was a basic food), was measured in leather bags named *xiquipilli,* each of which held 8,000 beans; other larger bags were made of *iztli,* a fibre obtained from the *Agave Sp.* For smaller measures the Mexicans used the *xicalli,* a series of cups of varying size. The *xicalli* was used for measuring *copal,* a resin which was employed in religious rituals and which always appears in the lists of goods offered as tribute.

For measurement of liquids such as water, *atolli* (honey), or *actli* (oils), the Aztecs used jars of graded sizes; *hueycomitl* was the larger size, *xoctli* the medium, and *xoctontli* the small size. According to León y Gama, in the *tianguixtli* or open market, where these measures were in daily use, inspectors were appointed and were empowered to destroy faulty measures and to mark accurate measures with a seal.

Bernal Diaz del Castillo recounted that the Indians would carry gold, the most precious of their metals, in feather quills so that the gold-dust packed inside could be seen. These quills were used

in varying lengths to pay for blankets, cocoa, and other staples. León y Gama calculated the Aztec taxation in pre-Columbian times by the weight of gold in the special cups or *xicatontli* used for the purpose, and giving the equivalent value in Spanish ounces, *castellanos, tomines,* and grains.

Measurement of length was established by means of a stick called *Tlacaxilantli,* derived from *tlacatl* (man), and *xillantli* (navel); the length was therefore the distance from the navel to the ground in a man, which is very close to a yard, or three Spanish royal feet. From the evidence on some old pottery it is thought that the *tlacaxilantli* was divided in half and in fifths. The other measure was the *Tlalmecatl,* or string used to measure distance, and this was the equivalent of twenty *tlacaxilantli.* Greater distances were measured by *Netlalolli* or *Necchuilli,* which means the distance which could be covered by a running man at a stretch.

There are many pre-Columbian and Colonial codices prepared according to the aboriginal technique that offer information on weights and measures in America among the Indian cultures, particularly those on taxation and topography. A general study on their scientific value will soon be published. Among them, the *Codex Tecpan Caltitlan* ca. 1593—one of many dealing with property claims and hereditary genealogies—contains an Indian map of some properties where the land is measured by reference to a human femur, drawn in the upper left corner; this is the only case, so far known, of the femur being used as a measure of length.

Though these systems of weights and measures appear to be both complex and erratic, it should be borne in mind that by the use of these standards and a vigesimal system for arithmetical calculation, not only the Aztec, but also the Maya, Mixtec, Zapotec, Tarascan, and Otomi, which were the most notable cultural horizons in Central America, were able to settle trading problems and to organize a complex system of taxes and tributes.